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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification ⁶ : C07C 69/734, 67/14, C07D 311/16, A61K 7/44		A1	(11) International Publication Number: WO 97/00851
			(43) International Publication Date: 9 January 1997 (09.01.97)
(21) International Application Number: PCT/GB96/01481		(81) Designated States: AL, AM, AT, AU, AZ, BB, BG, BR, BY, CA, CH, CN, CZ, DE, DK, EE, ES, FI, GB, GE, HU, IL, IS, JP, KE, KG, KP, KR, KZ, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, TJ, TM, TR, TT, UA, UG, US, UZ, VN, ARIPO patent (KE, LS, MW, SD, SZ, UG), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).	
(22) International Filing Date: 21 June 1996 (21.06.96)		<p>Published With international search report.</p>	
(30) Priority Data:			
9512855.9 23 June 1995 (23.06.95) GB			
9525162.5 8 December 1995 (08.12.95) GB			
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(54) Title: CHEMICAL COMPOUNDS AND METHODS OF PRODUCTION THEREOF			
(57) Abstract			
<p>A compound having formula (B) and salts or adducts thereof wherein R₁ and R₂ are the same or different and represent H, OH, NH₂, CO₂H or OR₆; R₄ and R₅ are the same or different and represent H, OH, NH₂ or OR₆; R₆ is a straight or branched chain C₁-C₁₆ alkyl, alkylene or alkyne or a substituted or unsubstituted homocyclic or heterocyclic aromatic group; R₃ is a substituted or unsubstituted homocyclic or heterocyclic aromatic ring which is in conjugation with a group R₇; R₇ is a substituted or unsubstituted homocyclic or heterocyclic aromatic ring, an alkene, or an alkane substituted with a functional group capable of entering into conjugation with R₃. Such a compound has the ability to absorb ultraviolet radiation in both the uVA and UVB regions of the ultraviolet spectrum and antioxidant activity, making it useful as an additive in a sunscreen composition and in a variety of cosmetic and non-cosmetic compositions including hair care products, inks, paints and dyes.</p>			
<p style="text-align: right;">(B)</p>			

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CHEMICAL COMPOUNDS AND METHODS OF PRODUCTION THEREOF

The present invention relates to novel compounds having properties which
5 make them useful as sunscreen additives, processes for their preparation
and formulations containing them, including formulations of cosmetic
products.

As the harmful effects of strong sunlight become more widely publicized
10 and concern grows over the depletion of the ozone layer, the general
public is becoming more aware of the harmful effects of atmospheric
ultra-violet radiation. In particular, the identification of atmospheric
radiation as a major causative agent in skin cancers has increased the
demand for effective and economic protection against atmospheric ultra-
15 violet radiation.

Of the three types of ultraviolet radiation, uvA, uvB and uvC, uvC does
not penetrate the earth's atmosphere, being absorbed by the ozone layer.
Of the two types of ultraviolet radiation that reach the earth's surface, uvB
20 has been identified as the causative agent of skin cancer. Accordingly, the
majority of sunscreens currently available concentrate on the reduction of
uvB rays contacting the skin. However, uvA has now been identified as
a cause of ageing of skin and hair wrinkling. As such, it is considered
preferable to provide sunscreen agents which reduce the harmful effects
25 of both uvA and uvB in sunlight.

When used in cosmetic preparations there is a desire in the art to produce
sunscreens which not only have the primary function of blocking
ultraviolet light but also have the secondary function of caring for the skin
30 to which they are applied. Thus many sunscreens also contain

moisturisers and antioxidants as skin care additives.

Users of sunscreens require new materials with improved uv radiation absorbing properties in order to create improved products with substantially superior protective properties. These products would be advantageous for a variety of applications where uv protection is important, for example in a range of personal care products such as hair shampoos, conditioners and hairsprays, in polymers, inks, colouring materials such as paints and dyes and also to prevent uv induced degradation of other actives and additives formulated or added to a system. Ideally, such materials should exhibit the following properties:

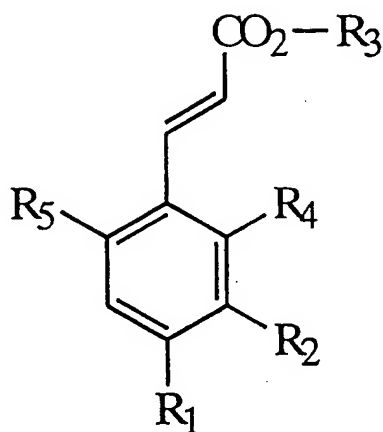
- Intense and broad spectrum absorbance covering both the uvB and uvA regions, so that very effective protection against cancer causing uvB radiation and skin-ageing uvA radiation can be achieved using easily co-formulated materials.
- Combined uvA and uvB absorption in just one molecule, instead of current products that must contain mixtures of molecules with different uv absorbing properties.
- High uv absorbance, thermostability and photostability, so that higher sun protection factor (SPF) products can be made much more easily, or so that lower concentrations of uv absorbing materials can be used.
- Antioxidant activity.

It has now surprisingly been discovered that certain novel compounds show a marked increase in uvB absorption and/or a particularly good

ability to absorb light emitted in the uvA and uvB wavelength regions of ultraviolet radiation.

According to the present invention there is provided a compound of the
5 formula B

(B)



and salts or adducts thereof,

10

wherein

R_1 and R_2 are the same or different and represent H, OH, NH_2 , CO_2H or OR_6

15

R_4 and R_5 are the same or different and represent H, OH, NH_2

or OR₆

5 R₆ is straight or branched chain C₁ - C₁₆ alkyl, alkylene or alkylyne or a substituted or unsubstituted homocyclic or heterocyclic aromatic group

R₃ is a substituted or unsubstituted homocyclic or heterocyclic aromatic ring which is in conjugation with a group R₇

10 R₇ is a substituted or unsubstituted homocyclic or heterocyclic aromatic ring, an alkene, or is an alkane substituted with a functional group capable of entering into conjugation with R₃

15 The preferred compounds of this invention may be used in sunscreen preparations that have the ability to absorb uv radiation in both the uvA and uvB region and measurements of this property are expressed by the terms defined below.

20 The definition of the values m.a.v. and E^{1%}_{1cm} are as follows: m.a.v. is the molar absorbance value (E) being the absorbance of one molar solution of a substance, measured in a 1cm path length cell at the given wavelength. E^{1%}_{1cm} is the specific absorbance of a substance being the absorbance of that substance at 1% concentration in a 1cm path length cell at the given wavelength. The total uv absorbance is a representation of the area under
25 the curve of the specific absorbance over the range 290nm to 450nm.

The preferred compounds described herein exhibit m.a.v. values > 1 x 10⁴ at wavelength maxima and exhibit a total uv absorbance > 4 x 10⁴.

30 Unexpectedly, it has further been discovered that for many of the

compounds of the invention, an alteration in pH of a solution of the compound results in an advantageous change in uv spectrum with a change in the measured λ_{\max} often resulting in two maxima where previously there had been one. This is embodied in the appearance of λ_{\max} in the uvA region of the spectrum in addition to a λ_{\max} in the uvB region and causes an increase in the total uv absorbance. The nature of the ionic species involved in changing the pH influences the extent of alteration of the UV spectrum. This allows for manipulation and alteration of the uv absorbance characteristics exhibited by the chemical compound.

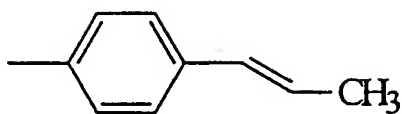
Alteration of the pH as described above can be effected by the use of acids or bases or Lewis acids or bases or solutions of buffer preparation containing these. Solutions of alkaline metal salts such as sodium hydroxide are, for example, of use in this respect. (See Advanced Organic Chemistry; Reactions, Mechanisms and Structure; J. March, McGraw-Hill, New York, 1968.)

Preferred embodiments of the present invention include compounds which individually exhibit combined uvA and uvB absorption properties. Accordingly, by using such a compound, rather than using separate compounds each exhibiting only one of either uvA or uvB absorption properties, the manufacture of product formulations is facilitated.

Preferred embodiments of the invention also include compounds which exhibit antioxidant activity. The antioxidant activity can be measured by one of two primary methods. One method is based on the protection of lipids from oxidation and is described in *Fat Sci. Technol.*, 1992, **94**, 428 by Marinova and Yanishlieva. Another method is based on the measurement of antiradical activity as described in *Lebensm.-Wiss. u-Technol.*, 1995, **28**, 25 by Brand-Williams, Cuvelier and Berset.

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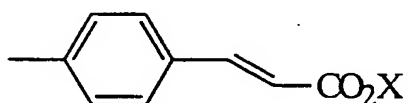
Suitable examples of R_3 include the following or salts thereof:



wherein the alkene bond can be either cis or trans,

5

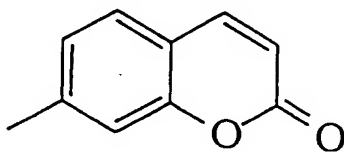
or



wherein the alkene bond can be either cis or trans and where CO_2X can

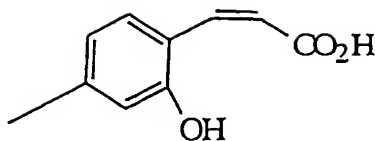
10 represent an acid or ester moiety.

or



15 which can be present in the form depicted or in the monocyclic form
which arises from hydrolytic cleavage of the cyclic ketone i.e.,

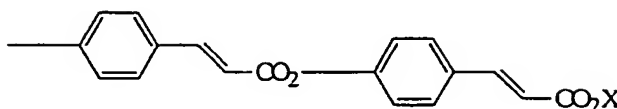
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wherein the alkene bond can be either cis or trans,

or

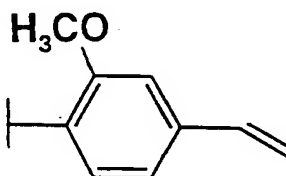
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wherein the alkene bond can be either cis or trans and where CO₂X can represent an acid or ester moiety,

10

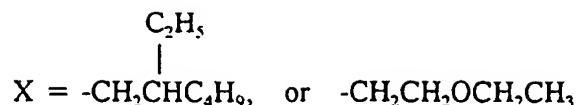
or



15

Preferably, the group CO₂X mentioned above as an example of R₃ represents an ester moiety. Particularly preferred esters include 2-(ethyl)hexyl esters or 2-ethoxyethyl esters, ie.

20



5 Conveniently, X represents a straight or branched chain C₁ - C₁₆ alkyl, alkene, or alkyne optionally incorporating a hetero atom replacement of a carbon to give, for example, an ether; also substituted or unsubstituted ring compounds, either homocyclic or heterocyclic including aromatic ring compounds.

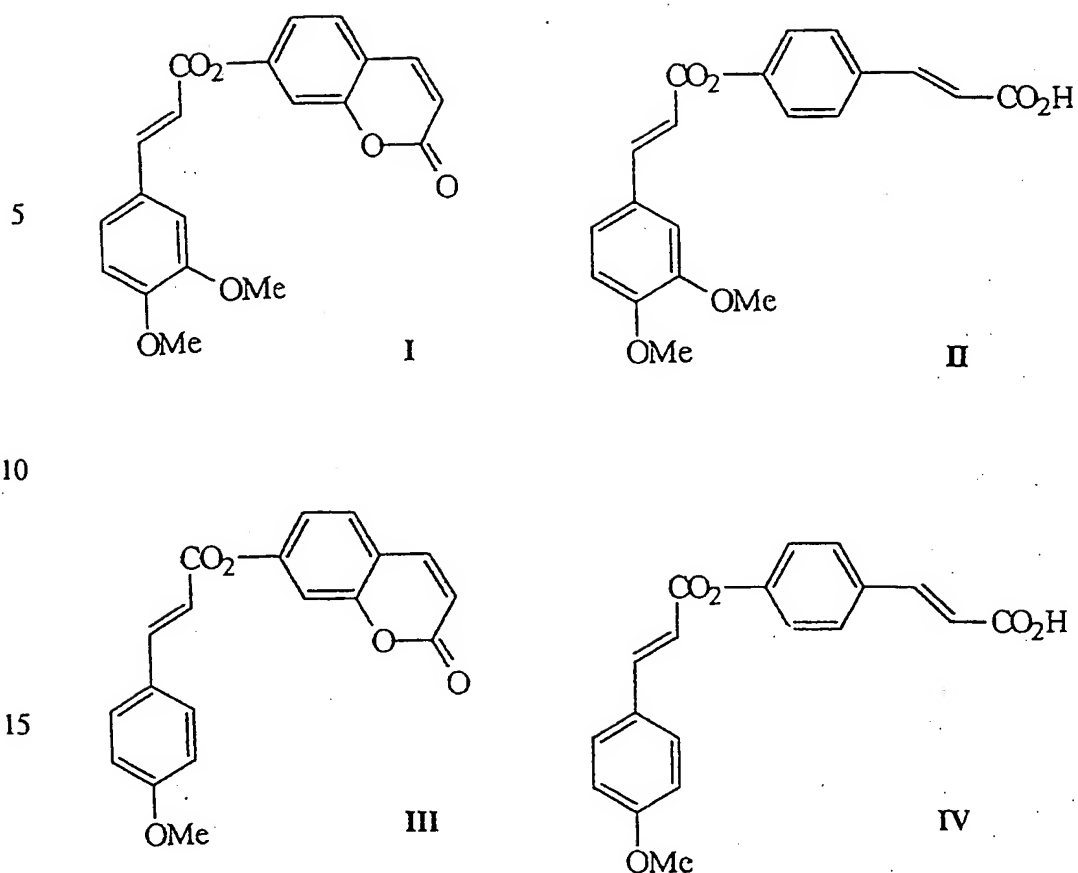
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Substitution of the above preferred examples of R₃ is optional.

A skilled person will appreciate that in some cases R₃ will contain functional groups capable of forming salts or polarised associations with
15 other ionic entities such as added acids or bases.

The present invention enables a large number of different formulations to be produced so as to cater precisely for particular consumer and product requirements. In addition, in certain preferred embodiments, which
20 comprise isomers which may be present in two forms, such as a trans form and a cis form, photochemical energy may be dissipated by reversible trans-cis isomerisation. This is a mechanism that is indicative of good photochemical stability.

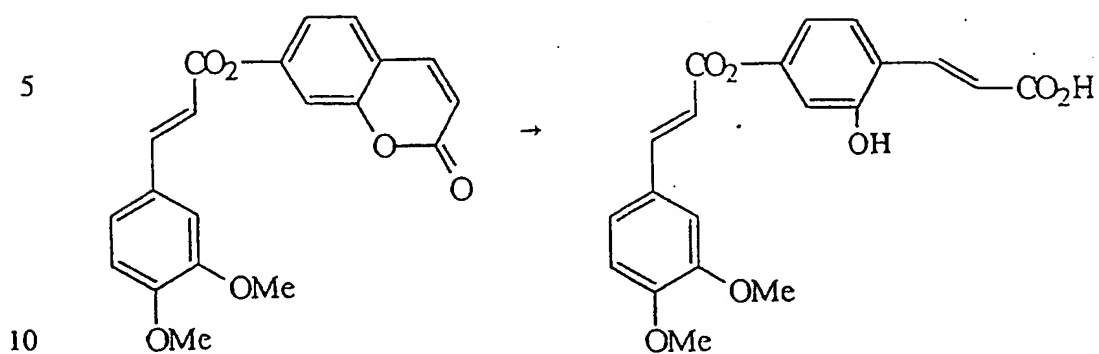
25 The common structural feature of the compounds of the present invention including each of the following examples:-



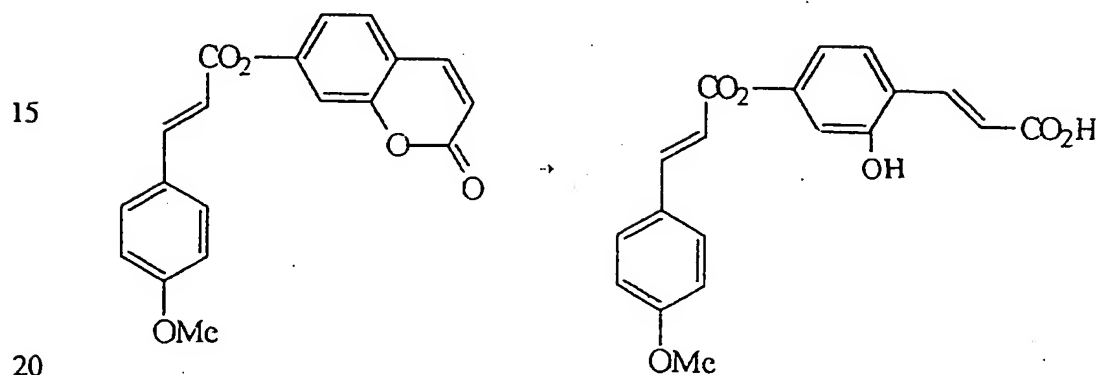
20 is that the ester radical R_3 is an aromatic ring further conjugated with a multiple bond or functional group capable of entering into conjugation. The conjugation may be continued through the carbon-carbon double bond to a carbonyl function in the form of a cyclic ester as in Structure I or in the form of an acid as in Structure II above. The carbonyl function may
 25 also be in the form of an ester of an acid e.g. the methyl ester of Structure II above.

The addition of base, which creates a corresponding salt or adduct, causes a shift in uv spectrum, resulting in compounds with improved properties.
 30 It is likely that, for the cyclic esters, the shift in uv spectrum may be

accompanied by a ring opening reaction, for example as shown below:-



or



Umbelliferyl 4-methoxycinnamate (Structure III) is a novel molecule that provides very intense absorption, double that of octyl methoxycinnamate, with a λ_{max} of 321nms. Upon addition of NaOH, intense and combined
 25 uvA and uvB absorption is obtained with λ_{max} of 376 and 310nms respectively. Such absorption is superior to that exhibited by known mixtures of uvA and uvB absorbing materials.

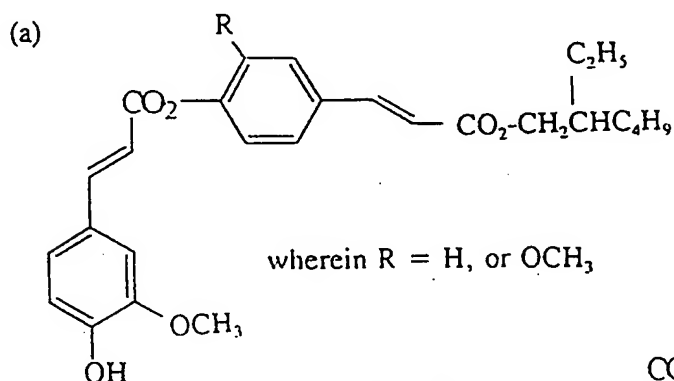
Preferably, R_1 represents hydroxy. The presence of a 4-hydroxy group
 30 appears to allow the UV absorption effect of the molecule to be shifted

more into the uvA region by adjusting the pH of a formulation containing the molecule.

Particularly preferred compounds of the invention include esters of ferulic acid, ie. compound B wherein $R_1 = OH$, $R_2 = OCH_3$, and R_4 and $R_5 = H$. Ferulic acid and its ester derivatives exhibit advantageous antioxidant activity.

Ferulic acid esters of especial interest include

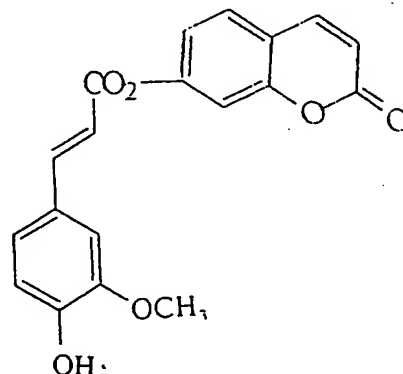
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15

and (b)

20



A skilled person will be able to synthesise the above preferred ferulic acid esters using standard methods. For example, compound (a) can be made by protecting the 4-hydroxy functionality of ferulic acid with a chemical protecting group which can be later removed such as an acetyl or benzyl group as described, for example, in Vogel's Textbook of Practical Organic Chemistry, A Vogel, revised B Furniss *et al*, Longman Scientific & Technical Publishing, 1989. Then formation of an acid chloride and

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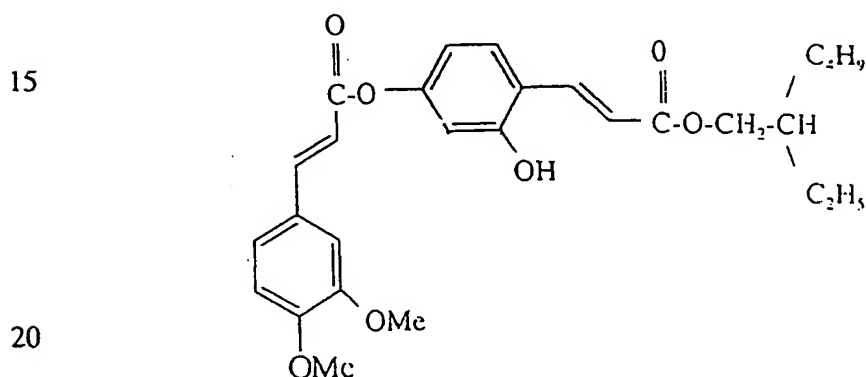
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reaction with ferulic acid ($R=OCH_3$) would form a cinnamate ester. Formation of a second acid chloride and reaction with 2-ethylhexan-1-ol is then followed by removal of the protecting group to give compound (a). An alternative approach is to use an enzyme catalysed reaction to
 5 condense 4-hydroxycinnamate acid ($R=H$) with ferulic acid and then again use enzyme catalysis to add the 2-ethylhexyl ester radical.

The 2-ethoxyethyl esters can be prepared in the same ways using 2-ethoxyethanol in place of 2-ethylhexan-1-ol.

10

A further preferred compound of the invention is



Methods for the preparation of the compounds embodied herein include methods for the formation of esters. Enzyme catalysed reaction to form
 25 an ester may be as described in outline in *Enzymes in Synthetic Organic Chemistry*, C-H Wong and G M Whitesides, Pergamon. Elsevier Science Ltd, 1994. Methods for coupling the acid functionality of a substituted cinnamic acid, for example caffeic acid, with an alcohol group, for example hydroxycinnamic acid, to form an ester encompassed by structure
 30 B are suitable. For the various products disclosed these methods can

include dehydration by azeotropic water removal, as described for example in Vogel's Textbook of Practical Organic Chemistry, A Vogel, revised B Furniss *et al*, Longman Scientific & Technical Publishing, 1989; mechanical or chemical water removal; conversion of the acid functionality to an activated derivative e.g. acid halide or activated ester followed by reaction with the alcohol; transesterification of a suitable ester derivative; enzyme catalysed ester formation from the acid and alcohol structure; enzyme catalysed transesterification of a suitable structure, e.g. chlorogenic acid. It will be apparent to a skilled person that control of the relative quantities of substrate and reagents used in the protocol for ester formation will determine the extent of ester formation.

In order to illustrate the features and advantages of the present invention, preferred embodiments of the present invention will be further described with reference to the following examples:-

EXAMPLE 1

3,4-Dimethoxycinnamyl chloride synthesis.

3,4-dimethoxycinnamic acid (52.1g, 0.25 mole) and thionyl chloride (28ml, 0.38 mole) were boiled under reflux in dry toluene (400ml) for 1 hour. The excess thionyl chloride was removed by repeated evaporation under vacuum from toluene. The solution was evaporated under vacuum to dryness to leave dimethoxycinnamyl chloride as a brown solid which was used without further purification.

EXAMPLE 24-Methoxycinnamyl chloride synthesis.

- 5 The procedure used here was identical to that described in example 1 with the use of 4-methoxycinnamic acid. The resulting product obtained was used without further purification.

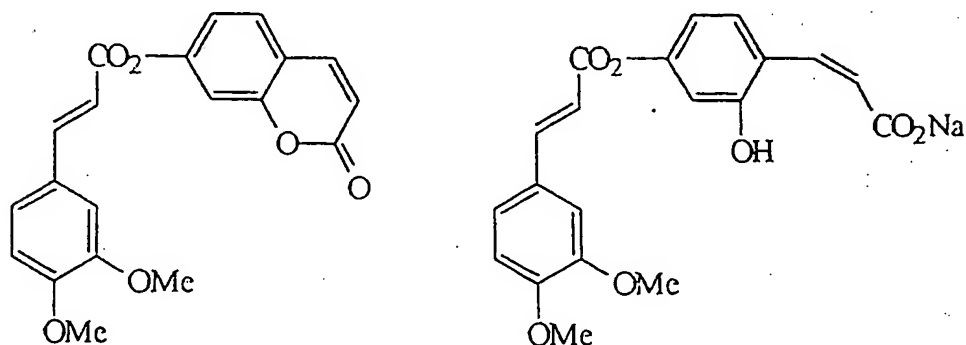
EXAMPLE 3

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Umbelliferyl 3,4-dimethoxycinnamate (3,4-Dimethoxycinnamic acid ester with 7-Hydroxycoumarin) synthesis.

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- The unpurified dimethoxycinnamyl chloride prepared in example 1 (25 mmole) was resuspended in toluene and added to umbelliferone (7-hydroxycoumarin, 3.9g, 25 mmole). The mixture was boiled under reflux for 1 hour and then left to cool. The resulting precipitate was filtered, dried and then recrystallised from ethanol to yield a white solid. m.p. 181-183°C.

- The UV spectrum of this material when measured as 0.001% w/v solution in ethanol exhibited a λ_{max} of 335nm; m.a.v. of 26787; $E_{1\%}^{1\text{cm}}$ of 761.

The addition of sodium hydroxide solution to the ethanolic solution gave a resulting UV spectrum of; λ_{\max} of 328nm; m.a.v. of 19782; $E^{1\%}_{1\text{cm}}$ of 562 and also λ_{\max} of 375nm; m.a.v. of 16614; $E^{1\%}_{1\text{cm}}$ of 472.

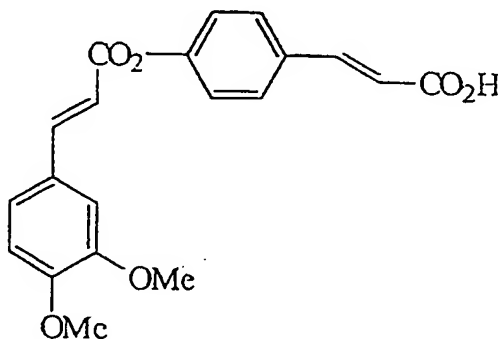
- 5 ^1H nmr, δ , J in Hz, (270 MHz, DMSO- d_6): 8.10 [1H, d, J 9.6]; 7.84 [1H, d, J 15.9]; 7.81 [1H, d, J 8.3]; 7.48 [1H, d, J 1.9]; 7.38 [1H, d, J 2.2]; 7.36 [1H, dd, J 8.2, 1.9]; 7.24 [1H, dd, J 8.2, 2.2]; 7.03 [1H, d, J 8.2]; 6.84 [1H, d, J 15.9]; 6.49 [1H, d, J 9.6]; 3.84 [3H, s]; 3.82 [3H, s].

10

EXAMPLE 4

- 15 4-Cinnamyl 3,4-dimethoxycinnamate (3,4-Dimethoxycinnamic acid ester with 4-hydroxycinnamic acid) synthesis.

20



25

- The unpurified dimethoxycinnamyl chloride prepared in example 1 (0.25 mole) was resuspended in toluene (400ml) and *p*-coumaric acid (4-hydroxycinnamic acid, 41.0g, 0.25 mole) was added. The mixture was
30 boiled under reflux for 1 hour and then left to cool. The resulting beige

16

solid was recrystallised twice from DMF/EtOAc to yield a light beige solid (36.6g, 41%) which was 85% pure and contained 15% of a double ester i.e. 4-(4-cinnamyl)cinnamyl 3,4-dimethoxycinnamic acid. At 90:10 ratio of products the m.p. was 194-197°C

5

The UV spectrum of this material when measured as a 0.001% solution in ethanol exhibited a λ_{\max} of 300nm; m.a.v. of 24743; $E^{1\%}_{1\text{cm}}$ of 697 and λ_{\max} of 328nm; m.a.v. of 25773; $E^{1\%}_{1\text{cm}}$ of 726.

10 ^1H nmr, δ , J in Hz, (270 MHz, DMSO- d_6): 12.44 [1H, br s,]; 7.82 [1H, d, J 15.8]; 7.78 [2H, d, J 8.8]; 7.63 [1H, d, J 16.0]; 7.46 [1H, d, J 1.6]; 7.35 [1H, dd, J 8.5, 1.6]; 7.26 [2H, d, J 8.5]; 7.03 [1H, d, J 8.6]; 6.82 [1H, d, J 15.8]; 6.54 [1H, d, J 16.0]; 3.83 [3H, s]; 3.82 [3H, s].

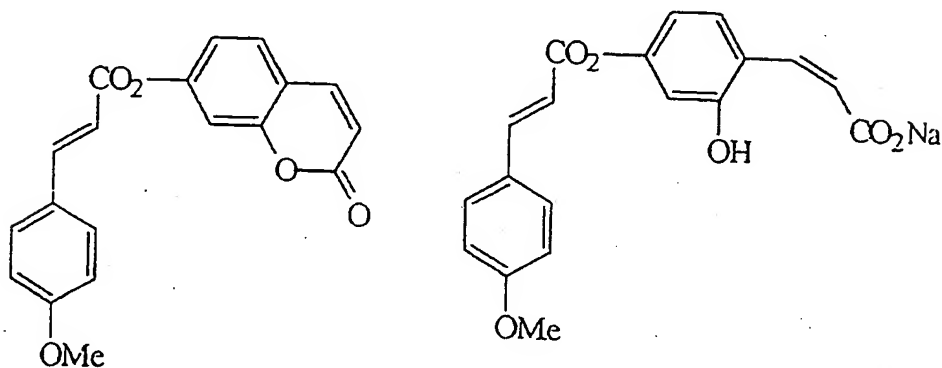
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EXAMPLE 5

Umbelliferyl 4-methoxycinnamate (4-Methoxycinnamic acid ester with 7-hydroxycoumarin) synthesis.

20

25



30 The unpurified 4-methoxycinnamyl chloride (0.57 mole) as prepared in

example 2 was resuspended in toluene (500ml) and added to umbelliferone (92.1g, 0.57 mole). The mixture was boiled under reflux for 1 hour and the precipitate which formed upon cooling was filtered, dried and recrystallised from DMF/EtOAc to yield a white solid (158.6g, 86%).
5 m.p. 194-196°C.

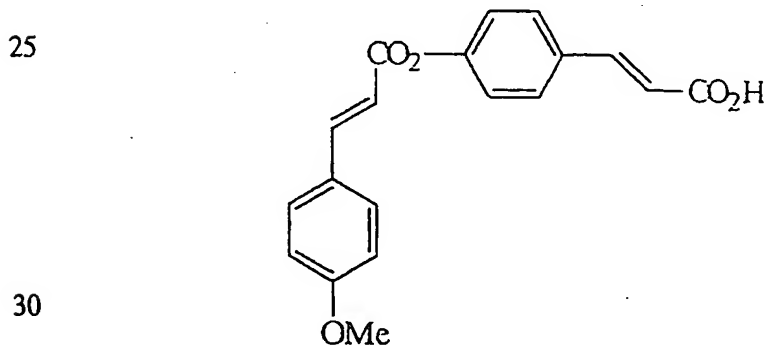
The UV spectrum of this material when measured as a 0.001% solution in acetonitrile exhibited a λ_{\max} of 321nm; m.a.v. of 43253; $E^{1\%}_{1\text{cm}}$ of 1342.

10 The addition of sodium hydroxide solution to the solution gave a resulting UV spectrum of, λ_{\max} of 310nm; m.a.v. of 23721; $E^{1\%}_{1\text{cm}}$ of 736 and also λ_{\max} of 376nm; m.a.v. of 17984; $E^{1\%}_{1\text{cm}}$ of 538.

¹H nmr, δ , J in Hz, (270 MHz, DMSO-d₆): 8.10 [1H, d, J 9.5]; 7.87 [1H, d, J 16.1]; 7.81 [1H, d, J 8.2]; 7.80 [2H, d, J 8.9]; 7.38 [1H, d, J 2.2]; 7.24 [1H, dd, J 2.2, 8.5]; 7.03 [2H, d, J 8.9]; 6.76 [1H, d, J 16.1]; 6.50 [1H, d, J 9.5]; 3.83 [3H, s].

20 EXAMPLE 6

4-Cinnamyl 4-methoxycinnamate (4-Methoxycinnamic acid ester with 4-Hydroxycinnamic acid) synthesis.



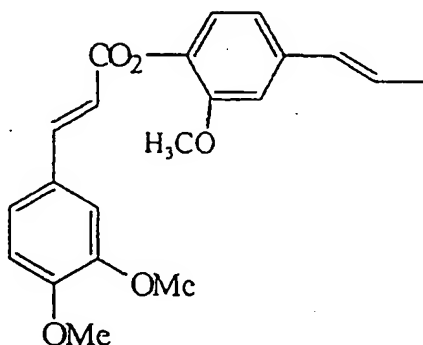
The unpurified 4-methoxycinnamyl chloride (28 mmole) as prepared in example 2 was resuspended in toluene (40ml) and added to *p*-coumaric acid (4.6g, 28 mmole). The mixture was boiled under reflux for 1 hour and the mauve precipitate which formed upon cooling was filtered and washed with diethyl ether to yield a white solid. This was dried with heating *in vacuo* to yield the title compound. (8.08g, 75% purity, 97% yield). The main impurity was the diester as described in example 8.

The UV spectrum of this material when measured as a 0.001% solution in ethanol exhibited a λ_{\max} of 312nm; $E^{1\%}_{1\text{cm}}$ of 908.

^1H nmr, δ , J in Hz, (270 MHz, DMSO- d_6): 7.84 [1H, d, J 15.9]; 7.78 [4H, d, J 8.8]; 7.63 [1H, d, J 15.9]; 7.26 [2H, d, J 8.8]; 7.02 [2H, d, J 8.8]; 6.73 [1H, d, J 15.9]; 6.53 [1H, d, J 15.9]; 3.82 [3H, s].

EXAMPLE 7

Isoeugenyl 3,4-dimethoxycinnamate. (3,4-Dimethoxycinnamic acid ester with isoeugenol) synthesis.



3,4 Dimethoxycinnamic acid (5g) was added to freshly distilled thionyl chloride (70ml) and dry benzene (50ml), and the mixture was boiled under reflux for 1 hour. The excess thionyl chloride was removed by repeated rotary evaporation with benzene being added each time to ensure complete removal. The crude acid chloride was then resuspended in benzene and added to isoeugenol (50ml), and the mixture was boiled under reflux for 40 mins. The cooled mixture was added to 1M NaHCO₃ solution (100ml) with careful release of pressure. The organic phase was removed and washed again with 1M NaHCO₃ solution (4 x 100ml), dried over Na₂SO₄ (anhydrous) and rotary evaporated to dryness. The crude ester was recrystallised from ethanol to give a fine tan powder in 58% yield, with a purity, determined by nuclear magnetic resonance (nmr), of approximately 90%, melting point (m.p.) 130-132°C.

The UV spectrum of this material when measured as a 0.001% solution in ethanol exhibited a λ_{\max} of 300nm; $E^{1\%}_{1\text{cm}}$ of 571 and also λ_{\max} of 327.5nm; $E^{1\%}_{1\text{cm}}$ of 689.

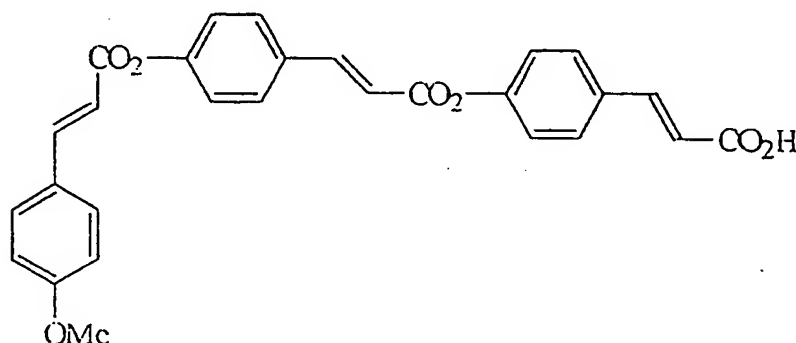
¹H nmr, δ , J in Hz, (270 MHz, CDCl₃): 7.81 [1H, d, J 15.9]; 7.15 [1H, dd, J 1.9, 8.1]; 7.11 [1H, d, J 1.9]; 7.02 [1H, d, J 8.1]; 6.96-6.86 [3H, m]; 6.54 [1H, d, J 15.9]; 6.38 [1H, dd, J 15.6, 1.4]; 6.19 [1H, dd, J 15.6, 6.6]; 3.92 [3H, s]; 3.91 [3H, s]; 3.84 [3H, s]; 1.88 [3H, dd, J 6.3, 1.4].

EXAMPLE 8

4-(4-Cinnamyl)cinnamyl 4-methoxycinnamate (4-Cinnamyl
4-methoxycinnamic acid ester with 4-hydroxycinnamic acid) synthesis.

5

10



To 4-methoxycinnamic acid (1.0g, 5.6 mmole) in benzene (10ml) was added thionyl chloride (14ml, 0.19mole) to form the acid chloride as described in example 2. To this was added 4-hydroxycinnamic acid 0.9g, 5.6 mmole) and the reaction mixture boiled under reflux for 1 hour. The precipitate which formed upon cooling the mixture (1.6g) was recrystallised from ethanol to give the title compound (1.4g).

The UV spectrum of this material when measured as a 0.001% solution in ethanol exhibited a λ_{\max} of 314nm; m.a.v. of >36989 ; $E'_{1\text{cm}}^{1\%}$ of >787 .

^1H nmr, δ , J in Hz, (270 MHz, DMSO- d_6): 7.92 [1H, d, J 16.2]; 7.91 [2H, d, J 8.6]; 7.85 [1H, d, J 15.9]; 7.80 [2H, d, J 8.8]; 7.78 [2H, d, J 8.8]; 7.66 [1H, d, J 15.4]; 7.31 [2H, d, J 8.6]; 7.28 [2H, d, J 8.8]; 7.02 [2H, d, J 8.8]; 6.90 [1H, d, 15.9]; 6.75 [1H, d, 15.9]; 6.54 [1H, d, J 16.0]; 3.82 [3H, s].

As can be seen from Examples 3 and 5 above, addition of a base such as

a Lewis base to certain preferred compounds of the present invention causes a shift in the ultraviolet spectrum for the compound, often with the appearance of a wavelength maxima in the uvA region of the spectrum in addition to a wavelength maxima in the uvB region of the spectrum and
5 an increase in total ultraviolet absorbance.

The compounds of the present invention, including the preferred compounds described in Examples 1 to 8, may be incorporated into product formulations such as creams, lotions and emollients either directly
10 as produced above or, alternatively, in the form of a salt or adduct thereof, for example, following addition of a base. Creams, lotions and emollients produced in this way are particularly useful as sun-care products due to their sunscreens effects which may be in both the uvA and uvB regions. Furthermore, such formulations are also useful as
15 health-care and/or cosmetic products because many of the compounds of the present invention have other useful properties such as antioxidant and antimicrobial activities and can help prevent or mitigate wrinkling and/or ageing of the skin and hair.

20 The creams, lotions or emollients into which the compounds of the present invention may be incorporated may be water-based or oil-based many may contain other useful components providing such properties as aroma, skin permeability, moisturisers, antioxidants and antimicrobial components.

25 Compounds of the present invention also have uses outside the cosmetic industry. The thermostability and solubility characteristics of these novel compounds together with their uv absorbing properties make them suitable for a variety of applications including incorporation into fabrics, dyes, polymers, inks, paints and other chemical compositions to confer
30 protection from light induced decomposition.

EXAMPLE 9Sunscreen

- 5 A sunscreen oil formulation comprises a compound of the invention and an adjuvant as follows:

10	cyclomethicone	64.9% weight
	UV absorber	6.0% weight
	capric/caprylic triglyceride	5.0% weight
	fragrance	0.1% weight
	isopropyl palmitate	24.0% weight

- The UV absorber is a compound of the invention. The relative proportion
15 of active UV absorber can be varied to alter the level of protection afforded by the sunscreen oil.

A water in oil sunscreen lotion of the invention comprises:

20	UV absorber	7.5% weight
	isopropyl palmitate	6.0% weight
	stearic acid	3.0% weight
	cetyl alcohol	1.0% weight
	glycerol monostearate	1.0% weight
25	water	66.5% weight
	sorbitol	3.0% weight
	Carbomer 934 (2% dispersion)	10.0% weight
	triethanolamine	1.2% weight
	fragrance and preservative	0.8% weight

30

Again, the relative proportion of active UV absorber can be varied to alter the level of protection afforded by the sunscreen lotion.

EXAMPLE 10**Hair products**

5 Incorporation of the compounds of the invention into hair products such as shampoos, conditioners, mousse and colorants is a preferred application. In the following examples the percentages refer to the weight of the ingredients.

10 (a) Conditioner formulation

	Distearyl dimethyl ammonium chloride	2.40%
	Hydroxyethyl cellulose	1.00%
	Cetyl alcohol	2.00%
15	Emulsifying wax	0.50%
	Perfume	0.50%
	UV absorber	2.00%
	Water	to 100.00%

20 (b) Hair spray formulation

	Vinyl acetate/crotonic acid copolymer	1.60%
	Aminomethyl propanol	0.15%
25	PEG-75 Lanolin	0.20%
	Ethanol	67.05%
	Butane	30.00%
	UV absorber	1.00%

30 (c) Hair mousse formulation

	Polyquaternium-11	3.00%
	Polyquaternium-4	1.50%
35	Hydrogenated tallow trimonium chloride	0.20%
	Nonoxynol-10	0.35%
	Ethanol	10.00%
	Water	73.45%
	Butane-48	10.00%
40	UV asborber	1.50%

In each case the relative amounts of ingredients can be varied to alter the properties of the product as desired.

EXAMPLE 11

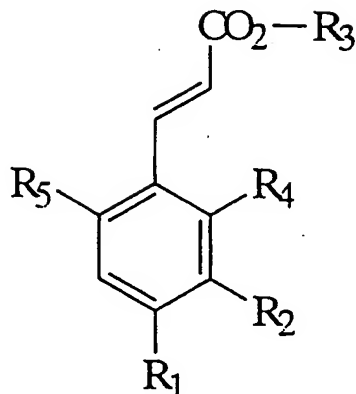
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Use of UV absorbers in plastics:

The UV absorber compound is incorporated at 0.5% w/w into polyolefin material prior to extrusion to form a plastic film which exhibits resistance
10 to light-induced decomposition.

CLAIMS

1. A compound having the formula:



5

and salts or adducts thereof, wherein

R₁ and R₂ are the same or different and represent H, OH, NH₂, CO₂H or OR₆,

R₄ and R₅ are the same or different and represent H, OH, NH₂
10 or OR₆,

R₆ is a straight or branched chain C₁ - C₁₆ alkyl, alkylene or alkylyne or a substituted or unsubstituted homocyclic or heterocyclic aromatic group,

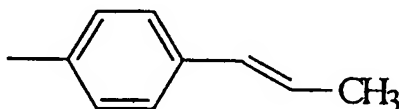
R₃ is a substituted or unsubstituted homocyclic or heterocyclic
15 aromatic ring which is in conjugation with a group R₇,

R₇ is a substituted or unsubstituted homocyclic or heterocyclic aromatic ring, an alkene, or an alkane substituted with a functional group

capable of entering into conjugation with R_3 .

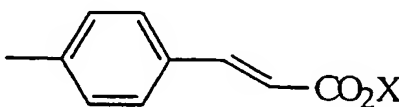
2. A compound according to Claim 1 which exhibits a molar absorbance value (m.a.v.) measured in a 1cm path length cell, of more than 1×10^4 at the wavelength of maximum absorbance, and/or exhibits a total ultra-violet absorbancy of at least 4×10^4 Abs nm for a 1% weight/volume solution.

3. A compound according to Claim 1 or 2, where R_3 comprises:



and wherein the alkene bond is either cis or trans.

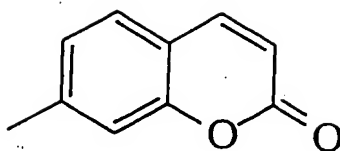
4. A compound according to Claim 1 or 2 wherein R_3 is :



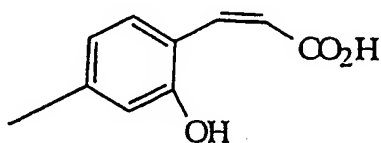
and wherein the alkene bond is either cis or trans and $CO_2 X$ represents either an acid or ester moiety.

5. A compound according to Claim 1 or 2 wherein R_3 comprises:

27

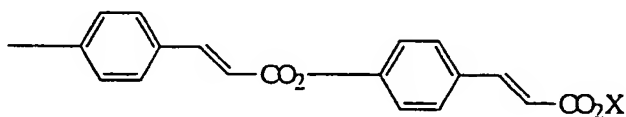


6. A compound according to Claim 1 or 2 wherein R₃ comprises:



and wherein the alkene bond is either cis or trans.

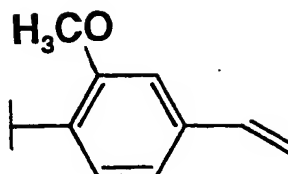
7. A compound according to Claim 1 or 2 wherein R₃ comprises:



and wherein the alkene bond is either cis or trans and CO₂X represents an acid or ester moiety.

8. A compound according to Claim 1 or 2 wherein R₃ comprises:

15



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9. A compound according to any of Claims 1 to 8 wherein R_1 is a para methoxy group.

10. A compound as claimed in any one of Claims 1 to 8 wherein R_1 represents OH and R_2 represents $-OCH_3$.

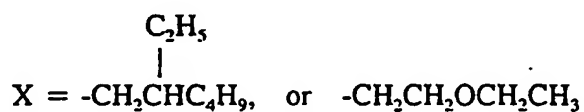
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11. A compound as claimed in Claim 4 or 7, wherein CO_2X represents an ester moiety in which X is a straight or branched chain $C_1 - C_{16}$ alkyl, alkene, alkylene which optionally incorporates a hetero atom replacement of a carbon; or a substituted or unsubstituted homocyclic or heterocyclic ring.

15

12. A compound as claimed in Claim 4 or 7 wherein CO_2X represents an ester moiety in which

20



13. A compound comprising a compound according to any of Claims 1 to 12, which compound has been subjected to an alteration in pH conditions which causes a shift in the ultra-violet absorption spectrum of the original compound.

25

14. A compound according to Claim 13, wherein the alteration in the

30

pH conditions results in an increase in total ultra-violet absorption.

15. A compound according to Claim 13 or 14, wherein the alteration
in pH conditions results in the appearance of an additional wavelength
5 maxima.

16. A compound according to Claim 15, wherein the additional
wavelength maxima is in the uvA region of the ultra-violet spectrum.

- 10 17. A compound according to any one of Claims 13 to 16, wherein
the alteration in the pH conditions is brought about by addition of a base.

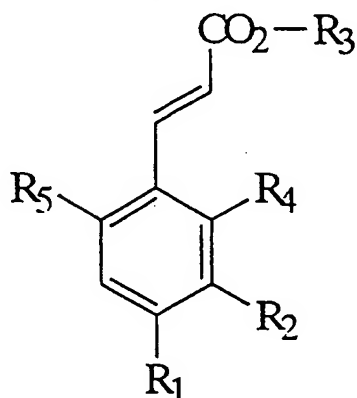
18. A compound according to any of Claims 1 to 17, comprising a
caffeate derivative.

15

19. A compound according to any of Claims 1 to 17, comprising an
coumarate derivative.

20. A compound having the formula:

20



and salts or adducts thereof, wherein

R_1 and R_2 are the same or different and represent H, OH, NH_2 , CO_2H or OR_6 ,

5 R_4 and R_5 are the same or different and represent H, OH, NH_2 or OR_6 ,

R_6 is a straight or branched chain $C_1 - C_{16}$ alkyl, alkylene or alkylyne or a substituted or unsubstituted homocyclic or heterocyclic aromatic group,

R_3 is an aromatic ring to which is conjugated a group R_7 ,

10 R_7 is either a homocyclic or heterocyclic aromatic ring or an unsaturated aliphatic group.

21. A method of producing a compound of any of Claims 1 to 20, which comprises esterification of 3, 4-dimethoxycinnamyl chloride.

15

22. A method of producing a compound according to any one of Claims 1 to 20, which comprises esterification of 4-methoxycinnamyl chloride.

20 23. A compound according to any of Claims 1 to 20, for use in the prevention or reduction of ultra-violet light damage to the skin or hair of warm-blooded animals.

24. Use of a compound according to any of Claims 1 to 20, for the
25 manufacture of a medicament for the prevention of or reduction of ultra-violet light damage to the skin of warm-blooded animals.

25. A cosmetic method of skin preservation, which method
30 comprises applying to the skin a composition comprising a compound according to any of Claims 1 to 20.

26. A cosmetic method of preventing or reducing wrinkling of skin or hair, which method comprises applying to the skin or hair a composition comprising a compound according to any one of Claims 1 to 20.

5

27. A sunscreen composition comprising a compound according to any of Claims 1 to 20 and an adjuvant.

28. A cosmetic composition comprising a compound according to any of Claims 1 to 20 and an adjuvant.

10

29. An anti-wrinkling composition for application to the skin or hair which composition comprises a compound according to any of Claims 1 to 20 and an adjuvant.

15

30. A composition for application to the skin or hair, which composition comprises a compound according to any one of Claims 1 to 20 and an adjuvant.

20 31. Use of a compound as claimed in any one of Claims 1 to 20 as an additive in a composition selected from hair care products, polymers, and colouring materials such as inks, paints and dyes.

25 32. A method of shifting the ultraviolet absorption spectrum of a compound as claimed in any one of Claims 1 to 12, or 18 to 20 comprising altering the pH conditions of the compounds environment.

33. A method as claimed in Claim 32 wherein the alteration in pH conditions is effected by addition of a base.

INTERNATIONAL SEARCH REPORT

Inter. Application No
PCT/GB 96/01481

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 C07C69/734 C07C67/14 C07D311/16 A61K7/44

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 C07C C07D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US,A,4 124 724 (JOHN W. AGORO) 7 November 1978 see column 10; claim 2 ---	1,20
X	FR,A,2 612 182 (CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE) 16 September 1988 see page 3, line 8 - line 33 see page 4, line 20 - page 5, line 9 see page 10 - page 11; examples 10,11 see page 23 - page 26; claims 1-3,6,15 --- -/--	1,4,20

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

* Special categories of cited documents :

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Date of the actual completion of the international search

4 September 1996

Date of mailing of the international search report

12. 09. 96

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Kinzinger, J

INTERNATIONAL SEARCH REPORT

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PCT/GB 96/01481

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DATABASE CROSSFIRE BEILSTEIN INFORMATIONSSYSTEME GMBH XP002012545 * BRN = 3185656 , BRN= 3186550 * see abstract & BULLETIN OF THE CHEMICAL SOCIETY OF JAPAN, vol. 2, 1927, TOKYO JP, page 24 ---	1,4,7,20
X	DATABASE CROSSFIRE BEILSTEIN INFORMATIONSSYSTEME GMBH XP002012546 * BRN = 3473014 * see abstract & JUSTUS LIEBIGS ANNALEN DER CHEMIE, vol. 384, 1911, WEINHEIM DE, page 244 & JUSTUS LIEBIGS ANNALEN DER CHEMIE, vol. 391, 1912, WEINHEIM DE, page 362 ---	1,10,20
X	JOURNAL OF THE SCIENCE OF FOOD AND AGRICULTURE, vol. 14, 1963, BARKING GB, pages 385-390, XP002012544 D.G.H.DANIELS: "Antioxidants in oats: Esters of Phenolic Acids" see page 387, paragraph 3 -----	1,20

INTERNATIONAL SEARCH REPORT

International Application No

PCT/GB 96/01481

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US-A-4124724	07-11-78	AU-B- 2036076	15-06-78
FR-A-2612182	16-09-88	NONE	